

REMARKS

By the present amendment, claims 1, 6, 7 and 36 are pending in the application.

Claim Amendments

Claim 1

In independent claim 1, the limitation --Mg: 0.005 - 0.1% -- has been added. The upper limit of 0.1% Mg appears in prior, now canceled, dependent claim 5. The lower limit of 0.005% Mg appears as "Present invention sheet No. 12" in Table 1 at page 63 of the specification.

Claim 36

Dependent claim 36 has been amended to improve clarity.

Specification - Title

The Title of the invention was objected to as not being descriptive of the invention to which the claims are directed.

In response to this objection, the Title has been amended by the present amendment.

In view of the present amendment, it is respectfully requested that the objection to the Title be withdrawn.

Claim Objections

Claims 8 to 10 were objected to under 37 C.F.R. §1.75 (c) as being of improper dependent form.

In response to this objection, claims 8 to 10 have been canceled by the present amendment.

In view of the present amendment, it is respectfully requested that the objection to dependent claims 8 to 10 be withdrawn as being moot.

§103

Claims 1, 6 to 10 and 36 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 4-350148 to Shimizu et al.

Claims 7 and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 4-350148 to Shimizu et al. in view of EP 0 497 992 to Sato et al.

Claim 5 was rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 4-350148 to Shimizu et al. in view of U.S. Patent No. 4,784,984 to Yamanaka et al.

These rejections, as applied to the amended claims, are respectfully traversed.

The Present Invention

The present invention provides a high Al-containing Fe-Cr-Al based stainless steel sheet.

The high Al-containing Fe-Cr-Al based stainless steel sheet is, as stated in the amended claim 1, characterized by comprising, by weight, Cr: 10 - 30%, Al: >6.5 - 15%, Si: 0.1 - 1.0%, Mn: ≤0.5%, La: 0.01 - 0.1%, Ce: 0.01 - 0.5%, P: 0.01 - 0.05%, Cu: 0.03 - 0.5%, Mg: 0.005 - 0.1% and either or both Ti: 0.02 - 0.1% and Nb: 0.02 - 0.3%, with the remainder being Fe and unavoidable impurities.

The high Al-containing Fe-Cr-Al based stainless steel sheet of the present invention has an excellent oxidation resistance and a satisfactory wettability of brazing materials.

That is, as disclosed at page 21, line 12 to page 22 line 18, the high Al-containing Fe-Cr-Al based stainless steel of the present invention contains more than 6.5% of Al and contains La, Ce and P to improve oxidation resistance and hot workability.

Although the oxidation resistance is greatly improved when the Fe-Cr-Al based stainless steel contains Al of more than 6.5%, wettability of brazing materials, which is important for a steel sheet used for a honeycomb body heating device and so forth, is impaired due to the formation of oxide film on the surface of the steel sheet during the heat treatment of brazing.

In order to improve wettability of the brazing materials of the steel sheet, the Fe-Cr-Al stainless steel sheet of the present invention further contains 0.03 to 1.0% of Cu and 0.005 to 0.1% of Mg.

Thus, according to the present invention, the Fe-Cr-Al stainless steel sheet has high oxidation resistance as well as good wettability of brazing materials in spite of containing a high Al content of more than 6.5%.

Patentability

Japan No. 4-350148 (“JP ‘148”)

JP ‘148 relates to a Fe-Cr-Al alloy excellent in durability and catalyst carrier using the same and discloses a Fe-Cr-Al alloy containing, by weight, C: ≤ 0.05, Si: ≤ 0.2%, Mn: ≤ 1.0%, P: ≤ 0.040%, Cr: 18 - 28%, Ni: ≤ 0.3%, Cu: ≤ 0.3%, Al: 1 - 10%, N: ≤ 0.02% and the balance Fe with inevitable impurities, and Si, Mn, P, Ni and Cu satisfying the equation below.

$$9.5 \text{ Si} + 2 \text{ Mn} + 10 \text{ P} + 3.6 (\text{Ni} + \text{Cu}) - 2.5 \leq 0$$

JP ‘184 also discloses that this steel may further contain, by weight, La: 0.01 - 0.20% (claim 2), one or more of Y: 0.05 - 0.5 and Hf: 0.01 - 0.3% in total amount of

lanthanide except La of 0.01 - 0.20% (claim 3) and at least one selected from Ti, Nb, Ta and V in total of 1.0% or less.

As described in paragraph [0010] of JP '148, since Si, Mn, P, Ni, Cu promote the deposition of intermetallic compounds at the grain boundaries of the honeycomb foil and promote embrittlement of the foil at high temperature, the content of these elements is preferably reduced to as low as possible. JP '148 discloses that it is necessary for Cu to be 0.3% or less.

Thus, JP '148 does not disclose or suggest adding Cu of 0.03 to 0.5% and Mg of 0.005 to 0.1% in order to improve wettability of the brazing materials in a high Al contain Fe-Cr-Al steel sheet.

Although, the Example steel A7 of JP '148 contains Cu of 0.03% and Al of 8.9%, this steel does not contain La, Ce and P as essential components. Therefore the effects of the present invention cannot be obtained by JP '148.

As explained above, JP '148 does not disclose or suggest improving wettability of the brazing material. More specifically, JP '148 does not disclose or suggest improvement of wettability of the brazing materials in the high Al-containing Fe-Cr-Al based stainless steel sheet by adding Cu and Mg in the specified ranges.

The present invention is different from the technology of JP '148 and cannot be derived from JP '148.

EP 0 497 992 ("EP '992")

EP '992 relates to a stainless steel for an automobile exhaust gas purifying catalyst carrier and process for preparation of the same and discloses a stainless steel foil which is a cold rolled, rapidly solidified foil comprising, by weight, Al: 1.0 - 20%, Cr: 5 - 30%, Mn: ≤ 2%, Si: ≤ 3% and C: ≤ 1, with the balance being Fe and unavoidable

impurities, wherein the thickness is 30 - 70 μm and the variation of the thickness is within \pm 20% of the average thickness.

Further, EP '992 discloses that the stainless steel may further contain, by weight, one or both of (a): at least one element selected from the group consisting of Y, Sc and REM: $\leq 0.3\%$ and (b) at least one element selected from the group consisting of Ti, Nb, Zr, Hf, V, Ta, Mo and W: $\leq 2\%$.

Although EP '992 discloses a Fe-Cr-Al stainless steel containing rare earth metal, Ti and Nb, EP '992 does not disclose or suggest the stainless steel must contain Cu and Mg in specified ranges in order to improve wettability of the brazing materials in a high Al containing stainless steel sheet.

Therefore, the present invention is not disclosed or suggested by EP '992 combined with JP '148.

U.S. Patent No, 4,784,984 ("US '984")

US '984 relates to a stainless steel ribbon for use as a catalyst carrier for automobile exhaust gas and discloses a ribbon of an Al-containing stainless steel ribbon having an Al content of 20% or less and an Si content of 3% or less, which is produced directly by a process of solidifying the Al containing stainless steel from a molten state thereof directly into a form of a ribbon at a cooling speed of at least 10°C/sec, thereby forming an Al-concentrated layer on a surface of the ribbon as solidified. The ribbon of US '984 has as an metallurgical structure a columnar structure with grain boundaries principally oriented in a direction along a thickness of the ribbon and a maximum grain diameter measured perpendicularly to the columnar axis of 30 μm .

US '984 also discloses that Mg may be included optionally in an amount of 0.01% or less. Col. 4, lines 17 to 23.

However, US '984 only discloses that Mg may be included in the relatively high Al containing steel sheet in order to improve oxidation resistance (Col. 4, line 17) and does not suggest adding Mg to improve wettability of the brazing materials.

Note that the Examples of Table 1 of US '984 contain 0.002% or less of Mg and no Cu which are outside the range of the present invention.

The present invention is not disclosed or suggested by combining JP '148 with US '984.

Summary

As explained above, although the cited references disclose a Fe-Cr-Al stainless steel containing rare earth metals, Ti and Nb, none of these cited references disclose or suggest improvement of wettability of the brazing materials which is an important characteristic for a high Al-containing Fe-Cr-Al stainless steel sheet for use, e.g., in the fabrication of honeycomb body, by adding the combined specified amount of Cu (0.03 to 0.5%) and Mg (0.005 to 0.1% to a high Al-containing Fe-Cr-Al stainless steel, in accordance with the present invention.

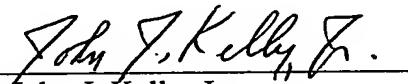
It is therefore submitted that amended independent claim 1, and all claims dependent thereon, are patentable over JP '148, in view of EP '992 and/or US '984.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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CONCLUSION

An action on the merits is respectfully requested.

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